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SUMMARY

A large strand of the research on exchange rates and stock prices relates the price dynamics to the interaction of various types of agents (chartists vs fundamentalists; informed vs uninformed, sophisticated vs naive). The proportion of each type of agents can move over time depending on their relative performance, on a probabilistic contagion process, or on both. Non linear price dynamics can be derived, including excess volatility, bubbles an chaos.

Three kinds of herding can be distinguished (Bikhchandani & Sharma, 2000): information-based herding (where herding stems from the Bayesian extraction of information from the observed behavior of other agents); reputation-based herding (where imitation is due to the uncertainty surrounding the relative ability of investment managers); and compensation-based herding (where herding is due to a compensation scheme that compares the performance of each investor to a benchmark). Herding is found to be detrimental since it reduces the information content of prices, and because, being based on little information, the prevailing consensus is very fragile. The consequence is a price which can move far away from its fundamental value, which displays high volatility and is subject to speculative bubbles.

All three types of herding can potentially affect the foreign exchange market. However, empirical evidence of herding so far has mainly concentrated on the stock market, with mixed results. In this paper, we try to bring some empirical evidence on the existence of some imitation behavior amongst professional forecasters of the exchange rate.

We use monthly survey data from Consensus Economics of London concerning the Deutschemark, the euro and the yen against the US dollar over 1990-1994 and 1996-2001. Through Granger-causality tests, we first study whether forecasters are influenced by the last published consensus (i.e. the last known average forecast), and conversely, whether one or several forecasters can be identified as leader(s) of the forecasting community. We then examine inter-individual causality relationships, through a step-by-step methodology involving Granger-causality tests and SURE estimations. This methodology allows to get rid of non robust relationships and spurious causality. The results allow to build a net leadership index for each forecaster that can be compared with his(her) performance over the period under consideration.

The results show that there are sequential connections between exchange-rate expectations of individual forecasters. However, it is not possible to identify one guru leading more than four other forecasters. Interestingly, imitation is not a specific feature of short run horizons, although individual leaders seem to be less persuasive at 12 months than at 3 months.

The weak relationship between the performance of each individual and his/her net leadership index tends to dismiss the hypothesis of a sequential reputation-based herding on the forex market, which would imply that successful forecasters become leaders, or that high reputation forecasters tend to herd more. Imitation hence would fall rather on the compensation and information types.

Our results emphasizing some limited evidence of herding are broadly in line with the literature on herding behavior in stock market recommendations. However we only deal here with sequential herding. Our monthly data set is not well disposed to detect any non-sequential herding (or sequential herding at a higher frequency), since it is not possible to disentangle such herding from simultaneous reactions to forecasters to public news. In addition, the link between forecasts and foreign exchange positions is far from clear-cut. Nevertheless, we believe our results can question sequential herding of forecasters as one major cause of long lived deviations of the exchange rate from its fundamental value.

ABSTRACT

In this paper we assess the extent of herd behaviour in the major foreign exchange markets using monthly survey data relative concerning individual forecasts for the DM (or euro) and the yen against the US dollar. We conduct Granger-causality tests and SURE estimations over two distinct periods (1990-1994 and 1996-2001) to analyze whether forecasters where subject to imitation during these periods. The results allow to compute leadership and “followership” indices. They show that, although most forecasters are connected to others through leading or imitation patterns, sequential herding is not a prominent feature of the market, at least at the monthly frequency. Moreover, there is no clear relationship between the degree of leadership and the performance of individuals. Hence, our results cast doubts on sequential herding of forecasters as one potential major cause of long-lived deviations of the exchange rate from its fundamental value.

JEL Classification: F31, F37

Key Words: herding, exchange-rate forecasts, survey data

IMITATION ENTRE PRÉVISIONNISTES DES CHANGES : UNE ÉTUDE EMPIRIQUE SUR DONNÉES D'ENQUÊTES

RÉSUMÉ

Une part importante de la recherche consacrée aux taux de change et aux cours boursiers relie la dynamique des prix à l'interaction entre différents types d'agents (chartistes contre fondamentalistes, informés contre non informés, perfectionnés contre naïfs). La proportion de chaque type d'agents peut évoluer au cours du temps en fonction des performances relatives, d'un processus probabilistique de contagion, ou des deux. Il en ressort une dynamique de prix non linéaire qui peut prendre la forme d'une volatilité excessive, de bulles spéculatives ou de chaos.

On distingue trois formes de mimétisme (voir Bikhchandani & Sharma, 2000): le mimétisme « informationnel » (où l'imitation provient de l'extraction bayésienne d'information à partir du comportement observé des autres agents) ; le mimétisme « réputationnel » (dû à l'incertitude qui entoure les capacités relatives des gestionnaires de fonds) ; et le mimétisme fondé sur les modes de rémunération (dans lequel la performance de chaque gestionnaire est comparée à une référence). Le mimétisme est préjudiciable car il réduit le contenu informatif des prix et parce que, à cause de ce faible contenu informatif, le consensus est fragile. La conséquence est un prix qui peut s'écarter très loin de sa valeur fondamentale, qui exhibe une forte volatilité et est sujet aux bulles spéculatives.

Les trois types de mimétisme peuvent affecter le marché des changes. Cependant, les études empiriques sur le mimétisme se sont intéressées, jusqu'à présent, essentiellement au marché boursier, et ont donné des résultats mitigés. Dans cet article, nous tentons d'apporter quelques éléments empiriques sur l'existence de mimétisme au sein des prévisionnistes professionnels des taux de change.

Nous utilisons les données d'enquêtes mensuelles du Consensus Economics de Londres concernant le Deutschemark, l'euro et le yen par rapport au dollar US sur les périodes 1990-1994 et 1996-2001. A l'aide de tests de causalité à la Granger, nous étudions d'abord si les prévisionnistes sont influencés par le dernier consensus publié (c'est-à-dire, la dernière prévision moyenne), et inversement, si un ou plusieurs prévisionnistes peuvent être identifiés comme des leaders de la communauté des prévisionnistes. Ensuite, nous examinons les relations de causalité entre individus, à l'aide d'une méthode pas-à-pas faisant appel à des tests de causalité à la Granger et à des estimations SURE. Cette méthodologie permet d'éliminer les relations de causalité non robustes ou fictives. Les résultats permettent de construire, pour chaque individu, un indice de leadership net, que l'on peut ensuite comparer avec sa performance au cours de la période.

Les résultats montrent qu'il existe des relations séquentielles entre les prévisions de taux de change des différents prévisionnistes. Toutefois, il n'est pas possible d'identifier un gourou

qui influencerait plus de quatre autres prévisionnistes. De manière intéressante, l'imitation n'est pas l'apanage des horizons courts, même si les leaders semblent être moins persuasifs à 12 mois qu'à 3 mois.

Le faible lien entre la performance de chaque individu et son indice de leadership net tend à infirmer l'hypothèse selon laquelle il existerait un mimétisme «réputationnel » sur le marché des changes, ce qui impliquerait que les prévisionnistes performants deviennent des leaders, ou que les prévisionnistes jouissant d'une bonne réputation tendent davantage au mimétisme. L'imitation serait alors due aux modes de rémunération ou à la recherche d'information.

Nos résultats, qui mettent en évidence peu de mimétisme, sont cohérents avec la littérature sur l'imitation entre analystes financiers. Cependant, nous nous intéressons ici seulement au mimétisme séquentiel. Nos données mensuelles ne sont pas adaptées pour étudier le mimétisme non séquentiel (ou le mimétisme séquentiel à plus haute fréquence), car il n'est pas possible de séparer ce type de mimétisme de la réaction simultanée des individus aux informations publiques nouvelles. En outre, le lien entre les prévisions et les prises de position de change est loin d'être clair. Néanmoins, nous pensons que nos résultats sont de nature à remettre en cause le mimétisme séquentiel des prévisionnistes comme une cause majeure des écarts durables des taux de change par rapport à leurs valeurs fondamentales.

RÉSUMÉ COURT

Dans ce travail, nous étudions l'importance des comportements mimétiques sur les principaux marchés des changes en utilisant des données d'enquêtes mensuelles concernant les prévisions individuelles sur le DM (ou l'euro) et le yen par rapport au dollar US. Nous conduisons des tests de causalité à la Granger sur deux périodes distinctes (1990-1994 et 1995-2001) pour analyser si les prévisionnistes ont été sujets au mimétisme durant ces périodes. Les résultats permettent de calculer des indices de leadership et de « suivisme ». Ils montrent que, même si la plupart des prévisionnistes sont reliés à d'autres par des relations d'imitation, le mimétisme séquentiel n'est pas une caractéristique essentielle de cette communauté, au moins en fréquence mensuelle. En outre, il n'y a pas de lien net entre le degré de leadership et la performance des individus. Par conséquent, nos résultats jettent un doute sur la responsabilité du mimétisme séquentiel dans les écarts des taux de change par rapport à leurs valeurs fondamentales.

Classification *JEL* : F31, F37

Mots-clefs : mimétisme, prévisions de taux de change, données d'enquêtes

IMITATION AMONGST EXCHANGE-RATE FORECASTERS : EVIDENCE FROM SURVEY DATA

Michel Beine[*] *, Agnès Bénassy-Quéré*[§] *and Hélène Colas*[¨]

1. INTRODUCTION

A large strand of the research concerning exchange rates and stock prices relates the price dynamics to the interaction of various types of agents (chartists vs fundamentalists; informed vs uninformed, sophisticated vs naive). The proportion of each type of agents can move over time depending on their relative performance (Frankel & Froot, 1986, de Grauwe et al., 1993), on a probabilistic contagion process (Kirman, 1993), or on both (Lux, 1995). Non linear dynamics can be derived, including excess volatility, bubbles an chaos (Shiller, 1984; Topol, 1991; de Grauwe et al., 1993; Lux, 1998). Alternatively, the contagion amongst market agents can be non-sequential as in Orléan (1995) or Cont & Bouchaud (2000), which leads to multiple equilibria and fat tails.

Early models based on herd behavior assumed a significant share of the population to deviate from perfect rationality, in the form of chartism, noise trading or feedback rules (de Long et al., 1990). However there has been substantial effort to rationalize herd behavior (see early papers by Orléan, 1989, Scharfstein & Stein, 1990, Banerjee, 1995). Bikhchandani & Sharma (2000) classify such rationalizations into three groups: information-based herding (where herding stems from the Bayesian extraction of information from the observed behavior of other agents); reputation-based herding (where imitation is due to the uncertainty surrounding the relative ability of investment managers); and compensation-based herding (where herding is due to a compensation scheme that compares the performance of each investor to a benchmark). Herding is found to be detrimental since it reduces the information content of prices, and because, being based on little information, the prevailing consensus is very fragile. The consequence is a price which can move far away from its fundamental value, which displays high volatility and gives rise to speculative bubbles.

Empirical evidence of herding so far has mainly concentrated on the stock market (see Bikhchandani & Sharma, 2000, for a review). A first group of studies uses the portfolio composition of fund managers, herding being defined as the propensity to buy or sell particular stocks at the same time, or as the tendency of portfolio weights to move in the same direction. A second group looks at herding amongst investment analysts and

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newsletters. It studies whether the various analysts tend to provide the same recommendation at the same time or with short delay (see Lakonishok et al., 1992; Grinblatt et al., 1993; Jaffe and Mahoney, 1998), or whether they follow one well-known newsletter (Graham, 1999). On the whole, these empirical investigations provide only mixed evidence of herding. They generally find that herding is less likely for the most traded stocks and for the most successful analysts (although analysts with high reputation are more likely to herd). A straightforward interpretation of these results is that (i) the proportion of private information is higher for small stocks (leading to more information-based herding), (ii) a low ability analyst has greater incentive to hide in the herd than a high ability analyst (leading to more reputation-based and more compensation-based herding), and (iii) a high reputation analyst has more to lose by being wrong against the benchmark, which leads to reputation-based herding.

All three types of herding can potentially affect the foreign exchange market. In particular, Lyons (2001) argues that, although market fundamentals cover macroeconomic variables which are public knowledge, private information does exist on this market. Such private information, which is conveyed by order flows, mainly concerns the way news concerning fundamentals are to be interpreted. It is also related to short-run inventory constraints and risk aversion of market dealers. Some macroeconomic announcements and policy actions such as central bank interventions can also contain private information in the short run. For instance, Peiers (1997) and Dominguez (1999) show how information concerning central bank interventions spreads through the interbank market within a couple of hours after the transaction has taken place with one or a small number of leading banks. Similarly, D'Souza (2001) tests whether customer trades including central bank intervention contain short run private relevant information and whether dealers utilize this information in a strategic way.

In this paper, we try to bring some empirical evidence on the existence of some imitation behavior amongst professional forecasters of the exchange rate. Hence, our approach is in line with those studies based on the recommendations of investment analysts and newsletters. In particular, it is not clear whether the recommendations are followed by portfolio decisions: any herding found amongst forecasters will not translate into herd-based price dynamics. Conversely, any evidence in favour of herding is less likely to be spurious amongst forecasters than amongst portfolio investors because forecasts do not interact with trading rules (such as stop-loss rules).

In order to assess the extent of herd behavior, we use monthly survey data from Consensus Economics of London concerning the Deutschemark, the euro and the yen against the US dollar over 1990-1994 and 1996-2001. Although exchange rate survey forecasts can often be outperformed by random walk predictions, they could generate positive profits when used with a relevant trading rule (Eliott & Ito, 1999). Thus they can be considered as meaningful from a financial point of view. Following Peiers (1997), we carry out Granger-causality tests to assess whether one or several forecasters lead others.[1] We first study

[1] Peiers however works on tick-by-tick quotes instead of monthly forecasts.

whether forecasters are influenced by the last published consensus (i.e. the last known average forecast), and conversely, whether one or several forecasters can be identified as leader(s) of the forecasting community. We then examine individual causality relationships, through a step-by-step methodology that allows to get rid of non robust relationships and of spurious causality. Causality results allow to build a net leadership index for each forecaster that can be compared with his (her) performance over the period under consideration. It is worth noting that the Granger-causality methodology only accounts for sequential herding. Non-sequential herding can be very difficult to disentangle from similar reactions to public news.

The paper is organized as follows. The data set is briefly described in Section 2. Section 3 presents the methodology. In Section 4, the results concerning the causality between individual forecasters and the consensus forecast are commented. Section 5 presents the results for causality between individuals. Section 6 concludes.

2. DATA DESCRIPTION

We use survey data from *Consensus Economics* of London. Individual forecasts from over 100 individuals and financial institutions in the G7 capital cities are collected each month for the exchange rates of the US dollar against the Deutschemark (the euro after January 1999), the Japanese yen and the pound Sterling, at various horizons ranging from 1 month to 2 years. The survey is conducted on the first Monday of each month, and the results are published before the 15th of the corresponding month. Importantly, all individual forecasts are known *before* the next forecast is made. Two periods are considered: from January 1990 to December 1994, and from January 1996 to March 2001. Although the data source is the same for the two periods, it is not possible to connect the periods because a year of data is missing between periods and because there is a break in the forecasters flags.

We concentrate on the 1, 3 and 12-month forecasts for the yen and the Deutschemark (and euro) against the US dollar. The one-month forecasts are only available for the second period, while the 3 and 12-month horizons are available for both periods.

We deal with missing data by restricting the sample in the following way. For the first period, we select the 25 respondents that did not fail more than 4 times (once a year on average) on each of the two markets (JPY/USD and DEM-EUR/USD) and on each horizon (3,12 months). Hence, the number of answers is generally very close to 25 for each date/currency/horizon. For the second period, given the high number of missing values, we select those forecasters that did not fail more than 10 times provided they did not fail more than three times in a row. The number of forecasters ranges from 8 to 13 depending on the currency/horizon (Table 1). Note that the forecasters will not necessarily be the same across currencies and horizons for this second period, whereas they are strictly the same for the first period. Note also that we consider the EUR/USD market as the simple continuation of the DEM/USD one. This simplification is made possible by the fact that we work on expected percentage variations of exchange rates (see below).

The missing values for each individual are filled with his/her last reported one for the same individual.[2] This procedure biases the results *against* herding in favor of a simple auto-regressive process for each individual forecast series. Hence any finding of imitation will appear more robust. Finally, we use the panel average expectation calculated at each time on the whole panel (including those individuals not included in the present study) so that each individual forecast cannot have a significant mechanical impact on the panel average.

Table 1: Number of forecasters selected for each period/currency/horizon

	Horizon		
	1 month	3 months	12 months
1st period			
DM-EUR/USD	-	25	25
YEN/USD	-	25	25
2nd period			
DM-EUR/USD	8	12	12
YEN/USD	10	12	13

Nominal exchange rates are well known to be non stationary, whereas there first differences are generally stationary, at least within OECD currencies. This is fully confirmed for our data by unit root tests reported in Appendix A. Hence we work on the percentage of variation expected by each individual:

$$\Delta s_{i,t,t+h} = \ln\left(S_{i,t,t+h}\right) - \ln\left(S_t\right) \qquad (1)$$

where $S_{i,t,t+h}$ stands for the expectation of the exchange rate made at time t by individual i for time $t+h$. This quasi-differentiated variable is found to be stationary for most individuals on almost all markets and forecast horizons.[3] In the following, we drop the horizon subscript ($t+h$) for the sake of simplicity.

The key features of the data are reported in Table 2. On average, the US dollar was expected to appreciate against both the DM and, to a lesser extent, against the yen during the first sub-period. This contrasts with the overall stability of the USD/DM exchange rate and to the continuous depreciation of the USD against the yen during this period. Over the second sub-period, a depreciation of the USD was expected against the DM-EUR and (at the 12 month horizon) against the yen, but the USD appreciated against the DM-EUR whereas it appreciated and then depreciated against the yen. On the whole, then, expectations appear to be mean reverting. The failure of the panel to correctly predict

[2] This is why we only consider forecasters with no more than three missing values in a row.

[3] We found more evidence of stochastic trend for the DEM(Euro)-USD data over the recent sub-period (see Table A2). We should nevertheless be very careful in accepting these results as striking evidence of the presence of a unit root in equation (1) given the very low power of ADF tests for small samples.

exchange rates is illustrated by the mean squared error of the average forecast which displays the same order of magnitude as the expectation itself. Not surprisingly, the error is larger the longer the horizon, which corresponds to larger exchange rate variations. Finally, it is worth noting that the dispersion of expectations across the various forecasters is again of the same magnitude as the mean forecast as well as the mean squared error; it is higher for the yen than for the DM.

Table 2: Main features of the data

in %	**Mean expectation of the panel** (1)			**Mean squared error of the consensus** (2)			**Mean dispersion across forecasters** (3)		
	1M	3M	12M	1M	3M	12M	1M	3M	12M
1st period (1990-1994)									
DM-EUR/USD	-	1.40	3.76	-	0.93	1.44	-	2.97	4.76
YEN/USD	-	0.42	1.21	-	0.81	1.65	-	2.96	5.50
2nd period (1996-2001)									
DM-EUR/USD	-1.10	-1.86	-5.98	1.16	1.88	4.63	1.53	2.60	4.36
YEN/USD	0.28	0.28	-1.09	0.67	1.02	2.01	2.11	3.21	6.92

(1) a positive sign indicates an expected appreciation of the USD.

(2) $\frac{1}{T}\left(\sum_{t=1}^{T} error_t^2\right)^{1/2}$, where *error* is the percentage error of the panel average.

(3) $\frac{1}{T}\sum_{t=1}^{T} stdev_t$, where $stdev_t$ is the standard deviation of expected exchange-rate variations (in percentage) across forecasters at time t.

3. METHODOLOGY

Two types of herding are successively studied. In the first one, one or several individuals are influenced by the average forecast, or alternatively one or several individuals are leaders of the average. This first type of herding is diffuse in the sense that each individual cannot identify the forecasters that he/she follows or leads. The second type of herding identifies leader-follower couples. Hence this form of herding can be classified as reputation-based, whereas the first type can be of either type defined in the introduction.

3.1. Causality with the panel average

For each currency, each horizon and each period, we estimate the following VAR model, where $\Delta\bar{s}_t$ is the expectation of the panel average and the optimum number of lags p is determined using the Schwartz information criterion:

$$\begin{cases} \Delta s_{i,t} = c_i + \sum_{l=1}^{P} a_l^1 \Delta s_{i,t-l} + \sum_{l=1}^{P} b_l^1 \Delta \overline{s}_{t-l} + u_{i,t} \\ \Delta \overline{s}_t = c_j + \sum_{l=1}^{P} b_l^2 \Delta s_{i,t-l} + \sum_{l=1}^{P} a_l^2 \Delta \overline{s}_{t-l} + \overline{u}_t \end{cases} \quad (2)$$

We then proceed to two Granger causality tests:

Test 1: H_0: $b_1^1 = b_2^1 = \ldots = b_p^1 = 0$ against H_1: $\exists l / b_l^1 \neq 0$ (Granger-causality from panel average to individual *i*)

Test 2: H_0: $b_1^2 = b_2^2 = \ldots = b_p^2 = 0$ against H_1: $\exists l / b_l^2 \neq 0$ (Granger-causality from individual *i* to panel average)

If H_0 is rejected in both tests (no Granger causality), or if it is not rejected in both tests (double Granger causality), we conclude that there is no causality between *i* and the panel average. If only one null is rejected, we conclude to a one-way causality, from average to *i* (resp from *i* to average) in case H_0 is rejected in the first (resp second) test.

In order to improve the robustness of the causality tests, we successively use a Fisher test and a likelihood ratio test. For instance, in the case of the causality from the panel average to individual *i*, the Fisher test compares the sum of squared residuals of the first equation of (2) (denoted RSS1) with the sum of squared residuals of the same equation excluding $\Delta \overline{s}_{t-l}$ ($l=1, \ldots, p$) (denoted RSS0):

$$S_1 = \left[\frac{(RSS1 - RSS0)/\ p}{RSS1/(T-2p-1)} \right] \quad (3)$$

Under H_0, S_1 follows a $F(p,T-2p-1)$ distribution. We complement the Fisher test with a likelihood ratio test, taking advantage of the VAR specification. Like the Fisher test, the likelihood ratio test is based on the comparison of the estimates of the first equation of (2) with and without $\Delta \overline{s}_{t-l}$ ($l=1, \ldots, p$):

$$S_2 = T\left[\log\left|\Omega_1\right| - \log\left|\Omega_0\right|\right] \quad (4)$$

where Ω_1 is the estimated variance-covariance matrix of the residuals from OLS estimation of the first equation of (2) and Ω_0 is estimated variance-covariance matrix of the residuals from OLS estimation of the first equation of (2) in which $\Delta \overline{s}_{t-l}$ ($l=1, \ldots, p$) is excluded. Under H_0, the S_2 statistic follows a $c^2(n_1 n_2 p)$ distribution where n_1 is the dimension of $\Delta s_{i,t-l}$ and n_2 is the dimension of $\Delta \overline{s}_{t-l}$ ($n_1=n_2=1$ here). We reject H_0 if and only if both methods lead to the same conclusion and the causal b^j_i ($j=1,2$) coefficients are positive.

3.2. Causality amongst individuals

For each currency, each horizon and each period, we proceed in 4 steps, using both test statistics:

Step 1

For each couple (i,j) of individuals ($i < j$), we estimate the following VAR model, where the optimum number of lags p is determined using the Schwartz information criterion:

$$\begin{cases} \Delta s_{i,t} = c_i + \sum_{l=1}^{P} a_l^1 \Delta s_{i,t-l} + \sum_{l=1}^{P} b_l^1 \Delta s_{j,t-l} + u_{i,t} \\ \Delta s_{j,t} = c_j + \sum_{l=1}^{P} b_l^2 \Delta s_{i,t-l} + \sum_{l=1}^{P} a_l^2 \Delta s_{j,t-l} + u_{j,t} \end{cases} \tag{5}$$

We then proceed the same way as in section 3.1.

Step 2

Suppose two different forecasters *j* and *j'* are found leaders of the same individual *i* in Step 1. We test for the robustness of each causality relationship by introducing the first lag of the expectation of say *j'* in the VAR model for the (*i*,*j*) couple:

$$\begin{cases} \Delta s_{i,t} = c_i + \sum_{l=1}^{P} a_l^1 \Delta s_{i,t-l} + \sum_{l=1}^{P} b_l^1 \Delta s_{j,t-l} + c^1 \Delta s_{j',t-1} + v_{i,t} \\ \Delta s_{j,t} = c_j + \sum_{l=1}^{P} b_l^2 \Delta s_{i,t-l} + \sum_{l=1}^{P} a_l^2 \Delta s_{j,t-l} + c^2 \Delta s_{j',t-1} + v_{j,t} \end{cases} \tag{6}$$

We then proceed to the same Granger-causality tests between *i* and *j* than in step 1. This allows to reduce the number of causality relationships found in Step 1. Step 2 is iterated until all causality relationships are found robust to the inclusion of the lagged expectation of other leaders of the same individual as a control variable. Finally, causal relationships with significantly negative coefficients are removed.

Step 3

So far, the estimation procedure has neglected the possible relationships across equations. Of course, common shocks, although mostly unobservable, affect the way forecasters build their exchange rate expectations. We account for spurious herding stemming from common shocks by re-estimating all equations which include a causal relationship amongst individuals using the SURE methodology. The values of the correlations across equations suggest that, on average, the error terms are significantly and positively correlated: for both currencies and at all horizons, the correlations are most of the time positive, with a significant part of these correlations well above 0.4.[4] Accounting for common shocks results in a slight decrease in the number of causal relationships.

Step 4

For each individual ($i = 1$ *to* N), a leadership index (L_i) is defined as the number of individuals he(she) leads as obtained in Step 3. Similarly, a followership index (F_i) is derived as the number of forecasters which exert some leadership on the corresponding individual. Finally, the net leadership index (I_i) is the simple difference between the leadership and the followership index for each individual:

$$I_i = L_i - F_i, \qquad i = 1 \text{ to } N$$

The net leadership index theoretically ranges from –(N-1) to +(N-1), where N is the total number of forecasters.

3.3. Herding and performance

It has sometimes been shown in the literature that successful stock analysts are less likely to herd than low ability analysts (Graham, 1999). Symmetrically, leaders can be viewed as informed forecasters who should display higher accuracy than followers. Hence we try to relate the net leadership index of each analyst to his(her) personal performance over the period. Three alternative measures of performance are used which we borrow from Elliott and Ito (2001).

The first measure of performance is based on the root mean squared error of the forecasts, normalized for the performance of the random walk, which makes the performances comparable not only across individuals, but also across horizons and currencies:

$$PERF_{1,i} = \frac{RMSE_0}{RMSE_i},$$

$$\text{with } RMSE_0 = \frac{1}{T}\left(\sum_{t=1}^{T}\left(\Delta s_{t+h}\right)^2\right)^{1/2} \text{ and } RMSE_i = \frac{1}{T}\left(\sum_{t=1}^{T}\left(\Delta s_{i,t,t+h} - \Delta s_{t+h}\right)^2\right)^{1/2}$$

$RMSE_0$ is the root mean squared error of the naive model (based on a random walk), with Δs_{t+h} standing for the exchange-rate variation between t and t+h. $RMSE_i$ is the root mean squared error of individual i. Hence, a high ability forecaster should display high value of $PERF_{1,i}$.

[4] The results are available upon request.

The *second measure* of individual performance is based on a trading rule that consists in buying one dollar on the spot market when the dollar is forecasted higher than its forward rate, and to sell one dollar if it is forecasted lower. The normalized performance of individual *i* over the period is then:

$$PERF_{2,i} = BEN_i - BEN_o$$

$$with\ BEN_0 = \sum_{t=1}^{T} \left(\Delta s_{t+h} - \Delta f_{t,t+h}\right) \times SIGN\left(-\Delta f_{t,t+h}\right)$$

$$and\ BEN_i = \sum_{t=1}^{T} \left(\Delta s_{t+h} - \Delta f_{t,t+h}\right) \times SIGN\left(\Delta s_{i,t,t+h} - \Delta f_{t,t+h}\right)$$

$SIGN(x)$ is equal to *1* if $x > 0$ and -1 if $x < 0$. BEN_0 is the benefit that would obtain a naive forecaster who expects no change in the exchange rate and hence buys dollar on the spot market whenever the forward rate of the dollar is lower than the spot rate ($\Delta f_{t,t+h} = f_{t,t+h} - s_t < 0$). BEN_i is the benefit of individual *i* if he(she) bets on his(her) own forecast (assuming risk neutrality).

The *third measure* of performance is the ability of each individual to forecast the direction of exchange-rate change:

$$PERF_{3,i} = 100 \times \frac{C_i}{T_i}$$

where C_i stands for the number of correct predictions of the direction and T_i is the total number of forecasts of individual i. This third measure of performance should exceed 0.5 for a successful forecaster.

4. RESULTS

As described above, we first test for Granger causality between the panel average and each individual, and then test for causality across individuals.

4.1. Causality with the panel average

The causality relationships from individuals towards the panel average are reported in Table 3, whereas Table 4 reports the relationships from the panel average towards the individuals. Note that the results for the second period are less reliable than those for the first period due to the lower number of individuals. Three main comments are in order.

First, there are often more causality relationships at the 12 month horizon than at the 3 month horizon: diffuse herding of individuals (where individual forecasters lead or follow the average) is not specific to short horizons.

Second, individual forecasts for the yen/dollar exchange rate seem to have been led by the panel average over the first period, whereas a few individuals seem to have led the panel average over the second period.

Third, it is not possible to identify any leader of the panel average which would be the same for each currency and each horizon, although A6 is a leader in 3 cases out of 4. Vice versa, there is no 'pure' follower, but A2 and A19 are clearly led for the yen, A12 is led for the 3 month horizon, A11 and A25 are lead for the 12 month horizon. Note that the same individual can lead the average on a particular currency/horizon while being a follower for the same currency but a different horizon (for example, A7).

Table 3: Causality *towards* the panel average

	Horizon		
	1 month	3 months	12 months
1st period			
DM-EUR/USD	-	A5, A7 (8%)	A3, A5, A6 (12%)
YEN/USD	-	A3, A6, A16 (12%)	A6 (4%)
2nd period			
DM-EUR/USD	B8 (12.5%)	B2 (8.3%)	None (0%)
YEN/USD	B6, B8, B15, B17 (40%)	None (0%)	B2, B8, B11, B17, B19 (38.5%)

Source : econometric estimations. Percentage of leaders under parentheses.

Table 4: Causality *from* the panel average

	Horizon		
	1 month	3 months	12 months
1st period			
DM-EUR/USD	-	A12 (4%)	A7, A11, A18, A25 (16%)
YEN/USD	-	A2, A12, A17, A19, A24 (20%)	A1, A2, A3, A7, A8, A11, A13, A14, A16, A19, A21, A25 (48%)
2nd period			
DM-EUR/USD	B15, B17 (25%)	B4, B6 (16.7%)	None (0%)
YEN/USD	B21 (10%)	None (0%)	None (0%)

Source: Econometric estimations. Percentage of followers under parentheses.

4.2. Causality amongst individuals

Our econometric procedure is quite discriminative as the number of causality relationships falls dramatically from Step 1 to Step 3. Table 5 presents the leadership, followership and net leadership indexes as obtained from Step 4 for the first period. The table details the results for each currency/horizon as well as the sum of net leadership indices across currencies/horizons for each individual (last row) and the number of causality relationships for each currency/horizon (last column). The results for the second period are not reported since no causality relationship remains after Step 3. This feature can be related to the small number of forecasters over this period (8 to 13 depending on the currency/horizon, compared to 25 individuals in the first period) or to an evolution of the foreign exchange market.

Table 5 deserves the following comments.

- *Most individuals are involved in a causality relationship at least for one currency/horizon*. Indeed, only A3 seems to be independent from all other forecasters. A5 appears also independent for the yen as well as for the DM at 12 months, but he/she leads three individuals for the DM at 3 months. Three individuals (A9, A20, A23) seem to form independent expectations for the DM but not for the yen, while three individuals (A11, A25, A24) are in the opposite situation.

- Followership indices range from 0 to 2: followers appear to follow one or two individuals only. Conversely, leadership indices range from 0 to 4: leaders can lead as much as 4 individuals. *Although substantial, given the number of individuals involved in forecasts, this number is far from denoting a strong prominence of a few leaders in the market*.

- *Leaders are more prominent at the 3 month than at 12 month horizon*: at 3 months, A4 and A7, for instance, lead 3 or 4 individuals (depending on the currency) but do not follow any; at 12 months, A8, A20 and A22 are prominent leaders and prominent followers for the yen. However the total number of causality relationships is comparable for both horizons, which confirms the results obtained with the panel average.

- *On the whole,* the main leaders appear to be A5, A7, A12, A20 and A23, the main followers being A9, A16, A18 and A19.

Table 5: Leadership, followership and net leadership indices

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	SUM
DM																										
3 months																										
leadership	0	0	0	4	3	0	3	0	0	1	0	2	2	2	0	0	1	1	0	0	0	0	0	0	0	19
followership	1	1	0	0	0	1	0	0	0	1	1	1	2	1	1	1	1	1	1	0	1	1	0	1	2	19
net leadership	-1	-1	0	4	3	-1	3	0	0	0	-1	1	0	1	-1	-1	0	0	-1	0	-1	-1	0	-1	-2	0
12 months																										
leadership	2	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	1	2	0	0	2	11
followership	0	0	0	1	0	1	1	1	0	0	1	1	0	0	1	0	1	1	1	0	0	0	0	1	0	11
net leadership	2	0	0	-1	0	0	-1	-1	0	0	-1	0	0	0	-1	0	1	-1	-1	0	1	2	0	-1	2	0
YEN																										
3 months																										
leadership	0	1	0	2	0	0	3	0	0	3	0	2	1	0	1	0	0	0	0	1	0	1	2	0	0	17
followership	1	1	0	1	0	0	0	1	1	0	0	1	0	0	2	1	2	2	2	0	1	1	0	0	0	17
net leadership	-1	0	0	1	0	0	3	-1	-1	3	0	1	1	0	-1	-1	-2	-2	-2	1	-1	0	2	0	0	0
12 months																										
leadership	0	0	0	1	0	0	0	3	0	0	0	2	1	0	2	0	1	0	0	3	1	3	1	0	0	18
followership	0	1	0	1	0	0	1	2	2	1	0	0	1	1	0	1	1	1	1	1	1	1	1	0	0	18
net leadership	0	-1	0	0	0	0	-1	1	-2	-1	0	2	0	-1	2	-1	0	-1	-1	2	0	2	0	0	0	0
TOTAL NET	0	-2	0	4	3	-1	4	-1	-3	2	-2	4	1	0	-1	-3	-1	-4	-5	3	-1	3	2	-2	0	0

Source: econometric estimates and authors' calculations.

4.3. Herding and performance

The performance of the 25 individuals is plotted in Figure 1 with the three measures of performance averaged over the four currency/horizon combinations. Strikingly, the forecasters display very poor performances: their root mean square errors are larger than those of the naive model (PERF1 < 1); these results are consistent with those found by Eliott and Ito (1999); furthermore, their net gain from the trading rule is generally lower than what they would have obtained following the naive model (PERF2 < 0), and they generally do worse in predicting the direction of change of the exchange rate than if they had just flipped a coin (PERF3 < 50%). In fact, there is a high correlation between the three measures of performance: the correlation over the whole sample (not averaged) is 42% between PERF1 and PERF2, 67% between PERF1 and PERF3 and 56% between PERF2 and PERF3; the correlation on average measures is even higher: 66%, 67% and 92% respectively.

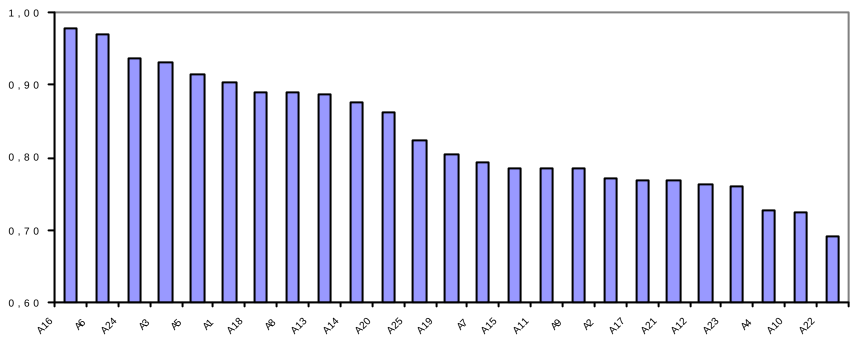
To assess the significance of these poor performances, we performed several statistical tests. First, we tested whether the difference between the performance of each individual and that of a naive forecaster with respect of the two first measures, i.e. the RMSE and the net gains drawn from implementing the trading rule, are significantly different from zero. The results are reported in Tables B1 to B4 in the Appendix B. Second, we tested whether the ability of each forecaster to predict the direction of the change in the exchange rate is significantly different from 0.5 (Tables B5-B6). As a whole, the statistical tests confirm that on average, these forecasters display very poor performances. For both currencies and forecast horizons, we find a lot of cases in which the RMSE of individual forecasts are significantly *higher* than the RMSE of the naive forecaster.[5] In no case, we find a significantly negative difference. Basically, these poor performances are confirmed by the difference in the net gains: in general, the gains of individuals are lower than the gains of the naive forecaster, with some significant differences especially over the recent period. In general, the ability to forecast the direction in the change is lower than twisting a coin, although a couple of forecasters achieve good performances on the YEN-USD market.

There is a slightly negative relationship between performance and net leadership: over the whole sample (not averaged), the correlation between net leadership and performance is -17% for PERF1, -7% for PERF2 and –9% for PERF3; the corresponding correlations on average measures of leadership and performance are –33%, -16% and –9%. This result is inconsistent with the view that successful agents are less likely to herd (Graham, 1999). On the contrary, net followers seem to be more successful. Alternatively, successful individuals tend to heard more, which would be consistent with reputation-base herding (successful forecasters have more to lose).

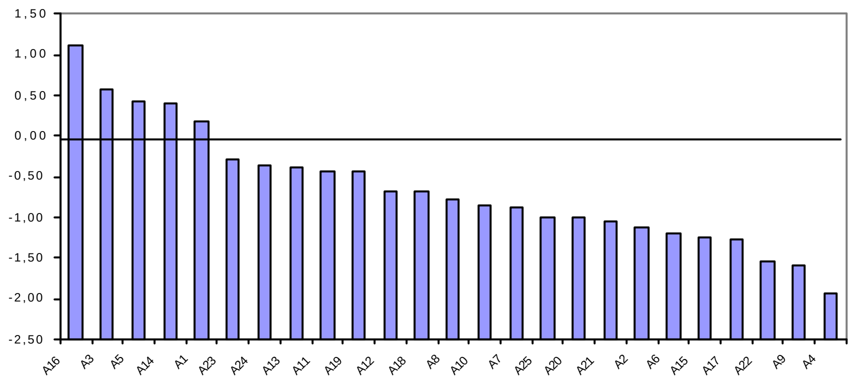
[5] The results are striking especially for the DM over the second period : at the 3 months horizon, *all* forecasters do worse than the naive one.

Figure 1: Three measures of individual performance

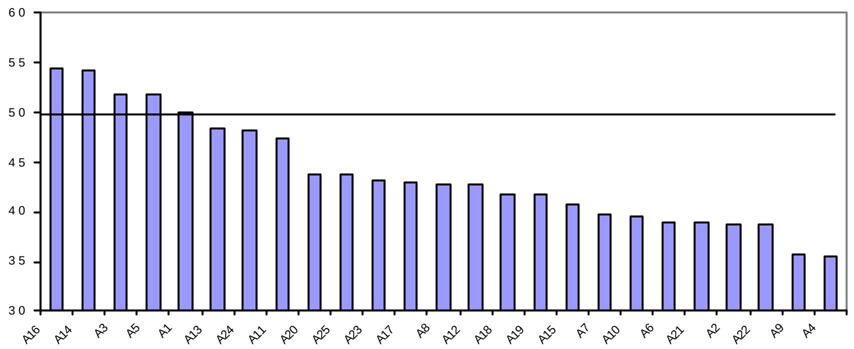
1a. Inverted root mean squared error relative to the naive model (PERF1)



2b. Net benefit from trading rule relative to the naive model (PERF2)



1c. Percentage of correct predictions of direction of change (PERF3)



Source : Authors' calculations on Consensus Forecast Data.

However it can be argued that successfulness should precede the behavior of forecasters in terms of leadership or followership. To tackle this problem, we calculate the correlation between the net leadership index (calculated over the 1990-1994 period) and the performance of each individual during the first year of the sample. The correlation is then much less negative and sometimes even positive (see Table 6). On the whole, there seems to be some independence between successfulness in 1990 and the net leadership index over the 1990-1994 period.

Table 6: Correlation between leadership and performance (in %)

	PERF1		PERF2		PERF3	
	1990-94	1990	1990-94	1990	1990-94	1990
Non averaged values	-16.6	1.3	-7.0	1.1	-8.9	-0.6
Average over currencies and horizons	-32.7	-5.5	-16.0	11.8	-9.0	4.4

5. CONCLUSION

The results provided in the paper show that there are sequential connections between exchange-rate expectations of individual forecasters. However, it is not possible to identify one guru leading more than four other forecasters. Interestingly, imitation is not a specific feature of short run horizons, although individual leaders seem to be less persuasive at 12 months than at 3 months.

The weak relationship between the performance of each individual and his/her net leadership index tends to dismiss the hypothesis of a sequential reputation-based herding on the FOREX market, which would imply that successful forecasters become leaders, or that high reputation forecasters tend to herd more. Imitation hence would fall rather on the compensation and information types.

Our results emphasizing some limited evidence of herding are broadly in line with the literature on herding behavior in stock market recommendations. However we only deal here with sequential herding. Our monthly data set is not well disposed to detect any non-sequential herding (or sequential herding at a higher frequency), since it is not possible to disentangle such herding from simultaneous reactions to forecasters to public news. In addition, the link between forecasts and foreign exchange positions is far from clear-cut. Nevertheless, we believe our results can question sequential herding of forecasters as one major cause of long lived deviations of the exchange rate from its fundamental value.

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APPENDIX A: UNIT ROOT TESTS

Table A1: Unit root test for $\Delta s_{i,t,t+h}$: DM

	1st period			2nd period		
Individuals	1 month	3 months	12 months	1 month	3 months	12 months
A1	-	-3.10***	-3.95***	-	-	-
A2	-	-1.87*	-1.20	-2.99***	-4.70***	-1.21
A3	-	-4.25***	-2.27**	-	-	-
A4	-	-4.08***	-0.72	-	-	-
A5	-	-6.68***	-4.74***	-1.93*	-3.90***	-1.12
A6	-	-1.12	-1.67*	-0.57	-4.22***	-1.13
A7	-	-2.22**	-1.90*	-	-	-
A8	-	-8.27***	-3.01***	-1.68*	-1.12	-1.33
A9	-	-1.75*	-2.40**	-2.84***	-3.80***	-1.15
A10	-	-2.59**	-1.68*	-4.02***	-6.74***	-1.37
A11	-	-0.92	-2.28**	-	-	-
A12	-	-6.88***	-4.17***	-2.18**	-7.33***	-1.51
A13	-	-2.38**	-4.33***	-	-	
A14	-	-4.83***	-3.10***	-	-	-
A15	-	-1.39	-1.61*	-5.24***	-6.51***	-1.59
A16	-	-4.43***	-3.16***	-	-	-
A17	-	-3.61***	-1.65*	-1.11	-1.61*	-0.48
A18	-	-4.63***	-1.33	-	-	-
A19	-	-2.69***	-2.86***	-	-	-
A20	-	-4.81***	-3.03***	-	-	-
A21	-	-3.73***	-2.52**	-4.61***	-4.55***	-4.53***
A22	-	-2.75***	-0.82	-	-	-
A23	-	-5.31***	-1.84*	-3.29***	-5.45***	-1.89*
A24	-	-4.64***	-3.47***	-4.72***	-7.39***	-1.50
A25	-	-2.67***	-0.86	-	-	-
Proportion of I(1)		12%	20%	8.3%	8.3%	83.3%

Notes: ADF tests ; number of lags needed to control for the presence of serial correlation ; serial correlation at order 4 assessed through a LM test with significance level of 5%.***,**, * denote significance respectively at the 1, 5 and 10% nominal levels. Proportion of I(1) gives the proportion of conclusions in favor of non stationary variables using a 10% significance level.

Table A2: Unit root test for $\Delta s_{i,t,t+h}$: YEN

	1st period			2nd period		
Individuals	1 month	3 months	12 months	1 month	3 months	12 months
A1	-	-4.81***	-1.77*	-	-	-
A2	-	-3.78 ***	-1.67*	-4.42***	-3.73***	-3.36***
A3	-	-3.62***	-2.86***	-	-	-
A4	-	-4.52***	-3.85***	-	-	-
A5	-	-4.70 ***	-2.17*	-3.20***	-3.37***	-3.92***
A6	-	-8.11***	-3.58***	-4.16***	-4.10***	-1.93*
A7	-	-3.28***	-2.55**	-	-	-
A8	-	-5.43***	-1.92*	-4.73***	-3.79***	-2.79***
A9	-	-2.24**	-1.63*	-4.87***	-4.92***	-3.73***
A10	-	-2.83***	-1.50	-7.09***	-4.91***	-2.28**
A11	-	-2.37**	-1.48	-	-	-
A12	-	-5.61***	-4.29***	-6.61***	-5.14***	-3.96***
A13	-	-4.55***	-4.89***	-	-	-3.53***
A14	-	-2.40**	-4.28***	-	-	-3.83***
A15	-	-1.96**	-1.79*	-5.01***	-	-2.85***
A16	-	-4.42***	-3.01***	-	-	-
A17	-	-5.21***	-2.56**	-4.23***	-	-1.94*
A18	-	-4.48***	-2.39**	-	-	-
A19	-	-3.66***	-2.20**	-	-	-
A20	-	-4.87***	-3.44***	-	-	-
A21	-	-4.50***	-3.29***	-6.27***	-3.26***	-1.88*
A22	-	-3.20***	-1.20	-	-	-3.01***
A23	-	-3.11***	-1.61*	-4.44***	-2.40**	-3.24***
A24	-	-6.30***	-3.82***	7.35***	-4.49***	-4.74***
A25	-	-6.33***	-1.69***	-	-	-
Proportion of I(1)		0	12%	0	0	0

Notes: see Table A1.

APPENDIX B: STATISTICAL TESTS OF FORECASTERS PERFORMANCES

Table B1: Significance of RMSE differential between each individual the naive forecaster: DM

	1st period		2nd period	
Individuals	3 months	12 months	3 months	12 months
A1	0.0014**	-0.0004	-	-
A2	0.0016	0.0079	0.0022**	0.0147*
A3	0.0019***	0.0007	-	-
A4	0.0036**	0.0083	0.0016**	0.0121**
A5	0.0015**	0.0013	0.0039***	0.0208**
A6	0.00003	0.0010	0.0018**	0.0160**
A7	0.0026***	0.0040	-	-
A8	0.0009***	0.0019*	0.0026***	0.0199***
A9	0.0020***	0.0046	0.0028***	0.0237***
A10	0.0040***	0.0094	0.0015**	0.0154**
A11	0.0001***	0.0029	0.0011*	0.0055
A12	0.0025***	0.0036	-	-
A13	0.0015***	0.0006	0.0021**	0.0146***
A14	0.0005	0.0004		
A15	0.0015	0.0079*	0.0016***	0.0160***
A16	0.0008*	0.0010	-	-
A17	0.0018	0.0089**	0.0077***	0.0267***
A18	0.0012*	0.0045	-	-
A19	0.0028**	0.0010	0.0021*	0.0057**
A20	0.0020***	0.0091***	-	-
A21	0.0020**	0.0059	-	-
A22	0.0034**	0.0155**	-	-
A23	0.0040***	0.0062*	-	-
A24	0.0005	-0.0012	-	-
A25	0.0006	0.0036	-	-
Consensus	0.0009*	0.0028	0.0014**	0.0115**

Notes: The table reports the coefficient of a regression of the RMSE differential between individual *i* and the naive forecaster on a constant ; the standard error used to evaluate the significance of this coefficient is corrected with a Newey-West estimator ; the number of lags is set as *h-1* where *h* is the forecast horizon. ***,**,* denote significance respectively at the 1,5 and 10% nominal levels.

Table B2: Significance of RMSE differential between each individual and the naive forecaster :YEN

	1st period		2nd period	
Individuals	3 months	12 months	3 months	12 months
A1	0.0014**	0.0019	-	-
A2	0.0016	0.0095	0.0026	0.013**
A3	0.0019***	-0.0010	-	-
A4	0.0036**	0.0124***	0.0028**	0.0057
A5	0.0015**	0.0001	0.0036**	0.0041
A6	0.00003	0.0032***	0.0017*	0.0075
A7	0.0026***	0.0056	-	-
A8	0.0009***	0.0048	0.0053***	0.0227***
A9	0.0020***	0.0132****	0.0016	0.0026
A10	0.0040***	0.0175**	-0.0002	0.0042
A11	0.0001***	0.0180**	-0.0007	0.0271
A12	0.0025***	0.0166***	-	-
A13	0.0015**	0.0024	0.0017*	0.0101***
A14	0.0016***	0.0079*	-	-
A15	0.0014**	0.0111***	0.0017*	0.0075*
A16	0.0002	-0.0014	-	-
A17	0.0018***	0.0180**	0.0105**	0.0448***
A18	0.0006*	0.0015	-	-
A19	0.0026***	0.0086	0.0018	0.0104
A20	0.0011**	-0.0008	-	-
A21	0.0031***	0.0009*	-	-
A22	0.0031***	0.0196**	0.0010	0.0041**
A23	0.0025***	0.0065	-	-
A24	0.0006	0.0052**	-	-
A25	0.0014**	0.0134**	-	-
Consensus	0.0008**	0.0039	0.0001	0.0041**

Notes: See Table B1.

Table B3: Significance of the net gain differential between each individual and the naive forecaster: DM

Individuals	1st period		2nd period	
	3 months	12 months	3 months	12 months
A1	-0.0069	0.0000	-	-
A2	-0.0125	-0.0433	-0.0211*	-0.1051**
A3	-0.0148	0.0065	-	-
A4	-0.0303*	-0.0566	-0.0232**	-0.1099**
A5	0.0006*	-0.0176	-0.0248*	-0.1308***
A6	-0.0105	-0.0442	-0.0190	-0.1161**
A7	-0.0305*	-0.0447	-	-
A8	-0.0142*	-0.0262*	-0.0318**	-0.1305***
A9	-0.0210	-0.0445	0.0364**	-0.1595***
A10	-0.0149	-0.0257	-0.0206*	-0.1452***
A11	0.0100	-0.0248	-0.0065	-0.0666*
A12	-0.0095	-0.0275	-	-
A13	-0.0062	-0.0235	-0.0229**	-0.1431***
A14	0.0033	-0.0000	-	
A15	-0.0134	-0.0531	-0.0318***	-0.1397***
A16	0.0043	-0.0021	-	-
A17	-0.0074	-0.0566*	-0.0516***	-0.2007***
A18	-0.0133	-0.0364	-	-
A19	-0.0210	-0.0037	-0.0204*	-0.0961**
A20	-0.0214	-0.0841**	-	-
A21	-0.0077	-0.0440	-	-
A22	-0.0193	-0.0610	-	-
A23	-0.0269*	-0.0416	-	-
A24	-0.0075	-0.0014	-	-
A25	-0.0041	-0.0468	-	-
Consensus	-0.0193	-0.0610	-0.0264*	-0.1248***

Notes : The table reports the coefficient of a regression of the net gain differential between individual *i* and the naive forecaster on a constant. The net gain is calculated using the trading rule presented in Section 3.3. The standard errors used to evaluate the significance of this coefficient is corrected with a Newey-West estimator ; the number of lags is set as *h-1* where *h* is the forecast horizon. ***,**, * denote significance respectively at the 1, 5 and 10% nominal levels.

Table B4: Significance of the net gain differential between each individual and the naive forecaster: YEN

	1st period		2nd period	
Individuals	3 months	12 months	3 months	12 months
A1	-0.0047	0.0239	-	-
A2	-0.0019	-0.0077	0.0049	-0.0461*
A3	0.0030	0.0396	-	-
A4	-0.0088	-0.0339	-0.0095	-0.0443
A5	0.0036	0.0484**	-0.0038	-0.0066
A6	0.0014	-0.0320	0.0177*	-0.0740
A7	-0.0137	0.0243	-	-
A8	-0.0163	0.0002	-0.0209	-0.1411**
A9	-0.0145	-0.0328	-0.0156	-0.0129
A10	-0.0032	-0.0119	-0.0005	-0.0387
A11	-0.0177	-0.0006	0.0116	0
A12	-0.0005	-0.0046	-	-
A13	-0.0024	0.0080	-0.0113*	-0.0635**
A14	-0.0021	0.0258	-	-
A15	-0.0032	-0.0103	-0.0235**	0.0161
A16	0.0144	0.0585**	-	-
A17	-0.0097	-0.0106	-0.0469***	-0.0643*
A18	-0.0061	0.0111	-	-
A19	-0.0216	0.0167	-0.0059	-0.0256*
A20	-0.0127	0.0518	-	-
A21	-0.0248*	0.0082		-
A22	-0.0066	-0.0160	-0.0092	-0.0078
A23	-0.0158	0.0636**		
A24	-0.0060	-0.0114	-	-
A25	-0.0022	0.0006	-	-
Consensus	-0.0066	0.0275	0.0076	-0.0058

Notes: See Table B3.

Table B5: Ability of individuals to forecast exchange-rate direction: DEM/USD

	1st period		2nd period	
Individuals	3 months	12 months	3 months	12 months
A1	0.47	0.60*	-	-
A2	0.40*	0.47	0.45	0.36**
A3	0.43	0.57	-	-
A4	0.31***	0.48	0.49	0.36**
A5	0.45	0.50	0.43	0.28***
A6	0.41	0.44	0.51	0.36***
A7	0.34**	0.40	-	-
A8	0.44	0.47	0.43	0.43***
A9	0.41*	0.49	0.33***	0.23***
A10	0.42	0.47	0.39*	0.25***
A11	0.56	0.49	0.57	0.52
A12	0.44	0.47	-	-
A13	0.46	0.53	0.50	0.17***
A14	0.52	0.63**		
A15	0.48	0.42	0.41*	0.25***
A16	0.47	0.47	-	-
A17	0.53	0.38**	0.31***	0.17***
A18	0.40	0.39**	-	-
A19	0.43	0.50	0.45	0.38**
A20	0.37**	0.37**	-	-
A21	0.38**	0.41*	-	-
A22	0.40*	0.40*	-	-
A23	0.30***	0.46	-	-
A24	0.48	0.57	-	-
A25	0.52	0.45	-	-
Consensus	0.38**	0.45	0.40*	0.33***

Notes: The table reports the proportion of correct directions of change predicted by individual *i*, and its significance from 0.5, using a studentized version of the sign-test statistic (see Diebold & Mariano, 1995).***,**, * denote significance respectively at the 1, 5 and 10% nominal levels.

Table B6: Ability of individuals to forecast exchange rate direction: YEN/USD

Individuals	1st period		2nd period	
	3 months	12 months	3 months	12 months
A1	0.43	0.5	-	-
A2	0.31**	0.38**	0.53	0.36**
A3	0.56	0.51	-	-
A4	0.38**	0.25***	0.46	0.59
A5	0.47	0.66***	0.49	0.45
A6	0.48	0.22***	0.36**	0.39*
A7	0.38**	0.47	-	-
A8	0.36**	0.44	0.39*	0.21***
A9	0.32***	0.21***	0.41*	0.57
A10	0.39*	0.31***	0.46	0.39*
A11	0.42	0.42	0.68***	0.58
A12	0.49	0.31***	-	-
A13	0.46	0.49	0.48	0.29***
A14	0.47	0.55	-	
A15	0.39*	0.33***	0.50	0.43
A16	0.53	0.70***	-	-
A17	0.43	0.37**	0.33***	0.13***
A18	0.40*	0.48	-	-
A19	0.32***	0.42	0.46	0.35**
A20	0.33***	0.68***	-	-
A21	0.32***	0.45	-	-
A22	0.42	0.33***	0.40*	0.30***
A23	0.33**	0.64**	-	-
A24	0.45	0.43	-	-
A25	0.45	0.34***	-	-
Consensus	0.42	0.43	0.35***	0.40**

Notes: see Table B5.

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